LUBRICATING OIL AND ITS USE

The invention relates to lubricating oil for food industry and its use.

In addition to the typical characteristics of lubricating oil, the requirements for technical oils for food industry machines include compatibility with a food product, because depending on the lubricating target, oil can be entrained in a food product. Especially in slicer and divider oils, which are used for lubricating blades that cut the food product into smaller pieces, the lubricant comes into contact with the food product being processed. The abovementioned machines are used especially in bakeries for slicing bread, and as an example of these machines and the manners for lubricating their blades can be mentioned US patent 6,192,779, European patent 878 276, European patent 15380, German application publication DE 44 37 625 and European patent 312978.

For lubricating the abovementioned machines and other food processing machines, there has been an aim to develop "food grade" oils, which otherwise have the characteristics required from lubricating oils, such as viscosity and antioxidation and stability in process conditions. As an example of these, it is possible to mention US patent 6,087,308, wherein the oil is based on synthetics and is suited for machines, wherein oil may occasionally come into contact with a food product, as well as the oil presented in US patent 5,691,285, which is based on vegetable oils, such as corn oil, olive oil, coconut oil or peanut oil. US patent 4,753,742 presents oil suited for dough dividers, which is based on food-approved mineral oil (pure white mineral oil), to which lecithin is added. The use of oils containing large amounts of vegetable oils in this type of machines is criticized in the patent in question.

The German application publication DE 2904827 (Horst Groneweg) presents a cutting oil composition for slicers. The basis of the oil is animal or vegetable fat, for example a mixture of soybean oil or turnip rapeseed oil, and solid fine-grained fat or wax is added to it in order to

form a film on the blade and to decrease friction between the blade and the bread.

Oils for slicers and dough dividers have been developed for 25 to 30 years by taking into account the device demands. Efforts have been made to provide a turnip rapeseed –based oil for slicers, mould lubrication and dividers, but the attempts have failed e.g. because of inadequate antioxidation.

In addition, especially for slicing bread, several technical characteristics are required of the oil in addition to food-approvability. Slicing finished bread is a procedure, wherein three materials are for a short time in interaction with each other: a moving metal blade, a thin oil film and the bread. In addition, the bread is aimed to be cut relatively shortly after baking, usually at a high temperature (40-60°C), which changes the characteristics of the oils being used too much into a harmful direction. The extent to which the bread sticks to the blade is also greater at higher temperatures. During dosage, the oil must spread evenly on the blade, it must have a good lubricity at the blade/bread boundary surface, the blade should wash itself in connection with cutting when the oil penetrates the bread, and the blade should remain free of the bread ingredients. The bread slices should also not be stuck together after slicing. Because spraying is a common oil dosage manner on the blade, it is desirable that the oil adheres well to the blade during spraying and no extra lubricating oil mist remains in the air.

For quite a while there have been combinations of different vegetable oils, waxes, lecithins and antioxidants on the market, which have been used as lubricating oils. The most well known manufacturer is the German Horst Groneweg GmbH & Co. KG with the trade name Dübör. The oils in question are classified as technical and not manufacturing oils, in which case declaration differs from a product used for food products. For example, antioxidants are not named and the source of lecithin is not indicated, nor are the E-codes.

In the future, a perfect food compatibility will be required also from technical oils, because the main part of the use of the applications in question ends up as nutrition with the product.

A purpose of the invention is to disclose a vegetable oil-based lubricating oil, which can be used as lubricating oil in the food product industry, and all of whose components are compatible with food, but whose technical performance is also good, even in the very demanding cutting and slicing of just baked bread or other bakery product.

The invention is a turnip rapeseed oil or rapeseed oil based oil, which can be used especially in slicing bread and as dough divider oil, but also in greasing moulds and pans before baking and as pan washing oil in bakeries. The basis of the invention is a perfect compatibility with food and a maximum functionality in applications.

By blending turnip rapeseed oil or rapeseed oil appropriately, a stabile well-lubricating oil mixture is achieved, which at the same time functions as a well-spreading and metal-surfaces-washing oil by utilizing the polarity and viscosity of turnip rapeseed oils and rapeseed oils – an advantageous viscosity/penetration change over a wide temperature area and also when the temperature increases. All this takes place without the vegetable oil polymerising in the abovementioned conditions, i.e. the non-polymerisation of this component is characteristic to the composition.

The oil according to the invention includes the following components, which are discussed more in detail later:

- turnip rapeseed oil or rapeseed oil, including the mixtures of different oils,
- auxiliary lubricant,
- emulsifier, and
- antioxidant.

Different turnip rapeseed oil or rapeseed oil grades, whose purification degrees are different, can be blended with each other into an

appropriate ratio in order to optimise lubricity, washing ability and dosage.

The lubricity of turnip rapeseed oil or rapeseed oil is not sufficient without an auxiliary lubricant, which can suitably be a pharmaceutical grade white oil (synthetic), possibly supplemented with fractions of hydrogenated turnip rapeseed oil or rapeseed oil raffinates (stable turnip rapeseed oil raffinates Akorex L and Akorex C), as well as fatty acid methyl esters (RME), ethyl esters (REE) and propyl esters (RPE) of turnip rapeseed oil or rapeseed oil. By means of the auxiliary lubricants a thin, even film of the oil can be formed on the blade, in which case the auxiliary lubricants function especially on the metal/oil contact surface.

The washability of the blades is achieved with emulsifiers, which can suitably be lecithins (E322), acetic acid esters of mono and diglycerides of fatty acids (E472a), sucrose esters of fatty acids (E473), or mono- and diglycerides of fatty acids (E471). In slicing bread, the water coming from the bread emulsifies into oil and functions as a material washing the blade, and the oil moves from the surface of the blade into the bread during the cutting.

Antioxidation can be achieved by standardizing the tocopherol level of the product. An added tocopherol is more sensitive, functioning as a fast antioxidant in operating conditions, whereas the natural tocopherol contained in turnip rapeseed oil or rapeseed oil improves the storage durability of the product.

Additional advantages can be provided with an aroma oil version, by means of which the aroma of the sliced surface can be changed into, for example, garlic. Any desired fat-soluble food product aroma can be used in the invention. In this manner, the lubricant can be utilized in the aroma formation of a bread or other food product being cut, which gets into contact with oil, in addition to technical lubrication.

An example composition, wherein the portions of the components described later may vary within wide limits, is as follows:

Turnip rapeseed oil or rapeseed oil: 80 to 99.7 weight-%
Auxiliary lubricant (e.g. pharmaceutical grade white oil): 0.05 to 10.00 weight-%
Lecithin (processed): 0.1 to 1.5 weight-%
Alfa-tocopherol (synthetic): 0.0001 to 0.001 weight-%
Gamma- and delta-tocopherol (synthetic): total 0.005 to 0.03 weight-%.

In the following are introduced the materials used in the oil composition according to the invention, the amount and characteristics of which are discussed later. Some materials are substantial parts of the oil composition according to the invention, while others are supplemental and optional.

The materials used

1 a) Turnip rapeseed oil bases:
- Raffinated (Mildola)
-SDG (Mildola), crude oil
- "Neito" (Mildola), raffinated restrictedly

1 b) Turnip rapeseed oil fractions:
- Akorex (Karlshamns)

2) Lecithins:
- Sternphil grades (E322) (Central Soya) hydrolysed lecithin with maximum thermal resistance, release and emulsification properties

3) Auxiliary materials:
- Citric acid (E330)
- Sorbic acid (E200)
- Propyl gallate (E310), Novakemia
- Butyl hydroxytoluene (BHT) (E321)
- Butyl hydroxyanisole (BHA) (E320)
- Tocopherols (E306), (E307), (E308), (E309)
- Pharmaceutical grade white oil (e.g. polydecene), Fortum

- Methyl, ethyl and propyl esters of turnip rapeseed oil (RME, REE, RPE)

4) Emulsifiers (other than lecithin):
- Mono- and diglycerides of fatty acids (E471)
- Acetic acid esters of mono- and diglycerides of fatty acids (E472a), Grünau
- Sucrose esters of fatty acids (E473), Sisterna

5) Aromas:
- Quest aroma agents (Biofincon Oy), (e.g. butter aroma)

The function of the turnip rapeseed oil or rapeseed oil component, of which there is typically at least 95 weight-%, advantageously at least 97.5 weight-% of the lubricating oil, is to function as the carrier of all other components and to lubricate the metal surfaces of the cutting blades by spreading over them quickly. This component consists, in a known manner, mostly of triglycerides of long chain fatty acids. As the base plants of the oils are turnip rape (Brassica rapa var. oleifera) and rape (Brassica napus var. oleifera), advantageously genetically non-engineered turnip rape or rape. The oil obtained from the seeds by pressing can be crude oil or more or less processed, in which case some components have been separated from it, e.g. lecithin. Turnip rapeseed and rapeseed oil are the most polar of vegetable oils, and they can be applied as lubricating oils spreading well on metal blades especially in dosaging taking place by misting. It has been noted that turnip rapeseed and rapeseed oil migrate well onto the surface of metal blades from a mist phase.

Aroma materials can be used, if necessary, to modify the characteristics of oil and to offer an aroma change in the finished product. From the point of view of technical functionality they are not essential.

Antioxidation

Antioxidation is obtained by means of natural tocopherols and lecithins, as well as a synthetic tocopherol combination. Synthetic tocopherol is sensitive and functions as a fast antioxidant in the slicing procedure. The natural tocopherol increases the storage durability of a product. The antioxidation of oil in storage can thus be maintained with an antioxidant contained inherently in the oil, which oxidates more easily than the double bond of the oil to be protected – gradually losing its effectiveness at the same time. In addition to the oil type, the requirement is affected by the packaging being used and the storage conditions.

Ratio: (portions of synthetic tocopherols)

Alfa (E307)	5 to10 %
Gamma (E308)	40 to 65 %
Delta (E309)	25 to 55 %

E306 = Tocopherol extract, which contains all the components E307 to E309.

There are a total of 0.005 to 0.03 weight-% of gamma- and delta-tocopherols, while the ratio between them can vary within the percentages described above. There is always alfa-tocopherol present in the tocopherols as well.

In the actual oil usage event the antioxidation is effected by a versatile assembly of requirements, which include higher temperatures, cutting forces, the water in the bakery product and other components of the dough, e.g. sugar. It has been detected that added synthetic tocopherol is more sensitive than the natural one. Synthetic tocopherols do not have an allergenic effect either, i.e. they are well suited for use with food products.

Citric acid is used in an amount of 25 to 100 ppm (25 to 100 g/ton of oil). The task of citric acid is adjusting the pH. It is also, however,

possible to decrease oil oxidation with citric acid in connection with the cutting blade, and it has a synergy effect with other materials.

Propyl gallate is used in an amount of 50 to 200 ppm (50 to 200 g/ton of oil).

A pharmaceutical grade white oil functions as an important part of the lubricant composition, an example of which is polydecene (e.g. Neste Medical White Oil). Polydecene is also know by the English names hydrogenated polydec-1-ene, hydrogenated poly-alpha-olefin. The following table presents more detailed information of the product:

Typical analysis values	**S22**	**S32**	**S46**
Density kg/m^3 15°C	820	825	830
Flash point °C (COC)	220	240	250
Pour point °C	–69	–60	–60
Viscosity index	130	135	135
Viscosity cSt/40°C	20	32	45
Viscosity cSt/100°C	4	6	8

Appearance: Clear, colourless and odourless oil.

Pharmaceutical grade white oil is used in an amount of 1000 to 5000 ppm (1000 to 5,000 g/ton of oil).

Pharmaceutical grade white oil is an inert synthetic lubricant, very pure (oxygen, nitrogen and sulphur compounds and aromatic compounds have been removed) liquid based on long-chain inert alkane hydrocarbons, which is characterized by odourlessness and colourlessness. This liquid functions in the composition as an auxiliary lubricant. It also contributes to release characteristics, as well as the blade coming off the bread and the bread slices not sticking to each other after slicing. As supplements of a synthetic auxiliary lubricant, also the processed turnip rapeseed oil Akorex L and/or Akorex C (Karlshamns) can be used as auxiliary lubricants, which can be used to "extend" the white oil. The materials in question are fractions of hydrogenated turnip rapeseed oil, which are obtained by separating the more solid fractions off when the temperature decreases. The

remaining fractions, which are fluid in room temperature, are completely inert. Corresponding fractions can be obtained from rapeseed oil.

Another alternative for an auxiliary lubricant is turnip rapeseed oil or rapeseed oil methyl ester (RME), which is a methyl ester of turnip rapeseed oil or rapeseed oil fatty acids, obtained in the interesterification of a corresponding vegetable oil with methanol. It is possible to use turnip rapeseed oil or rapeseed oil ethyl or propyl ester (REE, RPE) as well, which is obtained by interesterification with ethanol or propanol, respectively. These materials are also fluid in room temperature, in which case there is no problem of separation or particles during storage, which is a concern when using e.g. solid waxes.

An auxiliary lubricant is inert and oily in room temperature (20°C) and viscous enough. It can be more viscous in room temperature than the oil functioning as the main component. The auxiliary lubricant is used 0.1 to 2.0 weight-% in total in the lubricating oil composition.

At the boundary surface of metal and the product, a lubrication/release-characteristic, which prevents sticking, is to be created, as well as washing the metal surface, which takes place in connection with each product contact.

The primary task of lecithin is emulsification inside the oil – in such a manner that the antioxidant effects are maximized. A second task of lecithin is to function as a release material between metal and the product, as well as preventing the product slices from sticking. A third task of lecithin is to enclose metal particles into the film, which particles come off the chains, moulds and blades – thus, it ensures the prevention of the oxidation effects of metal ions, supporting the function of citric acid in the slicing procedure, which requires very fast protection. The fourth task of lecithin is to wash the metal surfaces by utilizing the moisture of the food product.

One possible lecithin is discussed in the following. Lecithin is hydrolysed lecithin, which has good release and emulsification properties and whose thermal resistance is advantageously at least 280 °C.

Sternphil HSB lecithin

Typical analysis values	
Phospholipids	min. 30 %
Insoluble material	max. 0,1 %
Water	max. 1,0 %
Acid number	max. 20
Peroxide number	max. 3
Iodine number (10 %)	max. 40
Viscosity (mPa.s) 25°C	max. 200

Lecithin is used in the amount of 1000 to 15000 ppm (1000 to 15,000 g/ton of oil), while the optimum is 5000 to 10000 ppm. The values describe the processed (hydrolysed) lecithin added to the oil, the effect of which lecithin is more efficient than the inherent lecithin possibly remained in the oil.

The combined effect of lecithin, tocopherols and citric acid in the slicing event is as follows: an antioxidant, an ion catcher and an emulsifier, as well as the release effect.

In the following recipe table, some possible lubricating oil compositions are presented, which can be used in bakeries as slicer oils and dough divider oils, as well as mould oils. The doses are given in weight-%. Tocopherol is given as added synthetic tocopherol and lecithin as added processed lecithin.

Raffinated turnip rapeseed oil	99.0539	88.8539	88.8739	99.6176	88.5293
"Neito"-oil	-	10.0000	10.0000	-	10.0000
Lecithin	0.8000	1.0000	1.000	-	0.8000
Citric acid	0.0200	0.0200	0.0200	0.0250	0.0220
Propyl gallate	0.0200	0.0200	-	-	0.0220
Polydecene	0.1000	0.1000	0.0500	0.0500	0.1000
Turnip rapeseed oil raffinate	-	-	0.0500	0.1000	-
Alfa tocopherol	0.0001	0.0001	0.0001	0.0002	0.0001
Gamma tocopherol	0.0030	0.0030	0.0030	0.0036	0.0033
Delta tocopherol	0.0030	0.0030	0.0030	0.0036	0.0033
E472a	-	-	-	0.1500	-
E473	-	-	-	0.0500	-
Aroma	-	-	-	-	0.5200

As a summary, the names of different materials, the E-codes and the manufacturers are provided in the table at the end. It is to be noted that the invention is not restricted to the materials coming from the manufacturers in question, but materials from other suppliers, which have the appropriate characteristics, can also be used.

Above, the use of oil especially as cutting oil in slicers is referred to, for which demanding environment the oil has the appropriate characteristics. The oil can also be used as the oil in the dough dividers separating the dough pieces at bakeries. In dough dividers, oil is used in lubricating mechanical parts, in which case it can occasionally be carried over to the dough as well, but also for lubricating the blades separating the dough pieces, in which case a contact with the food product is intentional. Similarly, lubricating oil can be used in lubricating moulds and pans and as pan washing oil, because thus it also comes between the metal and the food product before baking and e.g. its release properties can be utilized. When used as pan washing oil, the

lubricating oil is used to wash the pan after the previous baking, in which case a lubricating film for the next baking remains on it at the same time. Bakeries are substantial users of oil also in these applications.

Material	E code	Manufacturer
Raffinated turnip rapeseed oil		Mildola
"Neito" turnip rapeseed oil		Mildola
Lecithin 1 Hydrolysed lecithin with maximum thermal resistance, release and emulsification properties	E 322	Stern Lecithin (Central Soya)
Citric acid 2-hydroxy-1,2,3-propane-tricarboxylic acid	E 330	Algol
Propyl gallate	E 310	Novakemia
Polydecene		Fortum
Tocopherols		Novakemia
Alfa tocopherol	E 307	
Gamma tocopherol	E 308	
Delta tocopherol	E 309	
Turnip rapeseed oil raffinate Akorex L		Karlshamns AB
Acetic acid esters of monoglyseride of fatty acids Lamegin EE 190	E 472a	Grünau Illerliseen GmbH
Sucrose esters of fatty acids Sucroles SP 50	E 473	Sisterna B.V